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NOTES ON *AXIOPSIS (AXIOPSIS) SERRATIFRONS* (A. MILNE EDWARDS) (CRUSTACEA: DECAPODA: THALASSINIDEA)

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Abstract.—*Axiopsis (Axiopsis) serratifrons* (A. Milne Edwards) is recorded for the first time from several localities in the Atlantic. The species is redescribed, and observations on geographical distribution, morphological variation, and behavior in captivity are provided. It is concluded that this is a widely distributed tropical shallow water species.

The capture of several specimens of the common axiid shrimp inhabiting the shallow back-reef area at Carrie Bow Cay, Belize, led to problems of identification, which were complicated by examination of material from Florida and Bermuda. That axiid taxonomy, especially the status of the genera, is in flux (de Saint Laurent, 1979) did not help to resolve these problems. It was felt that refiguring and describing this, the type-species of the genus *Axiopsis,* and commenting on the range of variation, would cast a little light on axiid taxonomy.

Family Axiidae

Axiopsis (Axiopsis) serratifrons (A. Milne Edwards)

Figs. 1–5

Axia serratifrons A. Milne Edwards, 1873:11, pl. 2, fig. 6.
Axiopsis serratifrons.—Borradaile, 1903:538.—Sendler, 1923:44, pl. 6, fig. 10.
Axiopsis (Axiopsis) serratifrons.—de Man, 1925:72, pl. 6, fig. 12.
Axius serratifrons.—Rathbun, 1906:895.—Edmondson, 1923:27.
Axius spinipes de Man, 1888:464, pl. 19, fig. 6.—Zehntner, 1894:195.
Axiopsis spinipes.—Nobili, 1906:91.—Borradaile, 1903:538; 1910:262.
Axius affinis de Man, 1888:469, pl. 20, fig. 1.
Axiopsis affinis.—Borradaile, 1903:538; 1904:752.—Nobili, 1906:92.

Description.—Male. Carapace strongly sclerotised, with scattered shallow pits over entire surface posterior to cervical groove; rostrum triangular, extending beyond eyes, margins dentate/spinose, continuous with spinose lateral carina of gastric region of carapace; lateral carina not quite reaching cervical groove posteriorly; spinose median carine starting at about mid-length of rostrum and extending as far as lateral and submedian carinae;

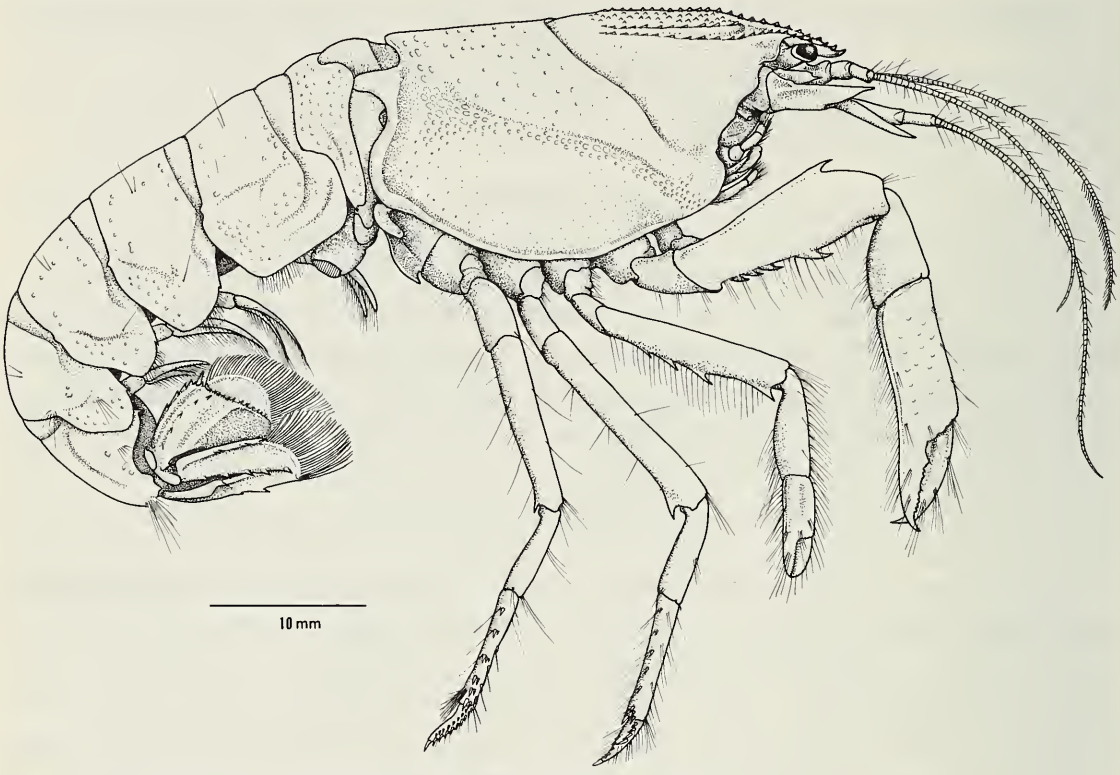

Fig. 1. *Axiopsis (A.) serratifrons*. Adult in lateral view.

latter starting in gastric region, spinose; numerous rounded and acute scattered tubercles between median and submedian carinae; antennal spine very short, subacute; anteroventral region of carapace broadly rounded; suprabranchial groove faint.

Pleon segments with scattered shallow pits. Pleuron of pleonite 1 ventrolaterally narrowed, with short distal marginal spine; pleuron of pleonite 2 broadly rectangular; pleura of pleonites 3–6 each with ventrolateral marginal spine.

Eyes extending to distal end of basal antennular segment; latter with short distolateral spine; second and third segments subequal; flagella equal in length. Antenna with outer peduncle spines flattened, elongate; inner spines short; fifth segment about two-thirds length of fourth. Mandibular palp 3-segmented, second segment twice length of basal segment; third segment longer and broader than second, with cluster of short curved spines on rounded apex; cutting edge bluntly rounded; molar transverse, rounded, with outer part hollowed. Maxilla 1 bilobed, both lobes distally broad, bearing short spines and setae; slender sparsely setose exopod 2-segmented. Maxilla 2, posterior lobe of scaphognathite with elongate modified seta armed with tiny spinules. Maxilliped 1 with broad bilobed epipodite. Maxilliped 2 terminal segment of endopod armed with short curved spines;

fourth segment elongate, with elongate setae on median margin; epipodite narrow, flattened, with attached podobranch. Maxilliped 3 with dactylus and propodus setose; carpus with single distal spine; merus with 4 spines on median margin increasing in length distally; ischium with 3 short spines on median margin, triquetral, inner surface with row of about 20 spines on raised ridge; basal segment with apically acute lobe on inner distal angle; epipodite slender, elongate, with attached podobranch. Pereopod 1, smaller cheliped, with fingers of chela shorter than palm, with ragged cutting edges; palm parallel-sided; carpus shorter than propodal palm; merus with single strong spine on upper margin, lower margin with 4 strong spines; ischium with 4 spines on inner ventral margin; coxa with short mediodistal spine. Larger cheliped, fingers only slightly shorter than palm; dactylus distally strongly curved, with single strong triangular tooth proximally; propodal finger with several tiny teeth proximally, becoming more irregular distally, inner and outer propodal surfaces bearing low tubercles. Pereopod 2 fingers slightly shorter than palm of chela, cutting edges straight, armed with short spines; carpus equal in length to chela; merus and ischium each with 4 spines on ventral margin; coxa with hooked spine at posterodistal corner. Pereopod 3 dactylus with 2 rows of short articulating ventral spines; propodus with single row of about 6 short spines on outer ventral submargin, distal spine strongest; carpus shorter than propodus, unarmed; merus with single strong ventrodistal spine; coxa with hooked spine at posterodistal corner. Dactylus of pereopod 4 with 2 rows of spines on outer surface; propodus with 2 rows of spine clusters on outer surface, plus dense ventrodistal cluster of slender finely serrate spines; carpus shorter than propodus, unarmed; merus with single ventrodistal spine; coxa with median hooked spine; sternal plate with strong anteriorly-directed spine on somewhat flattened process on each side. Pereopod 5 shorter than pereopod 4, dactylus with several ventral spines; grooming apparatus consisting of proximal hollow in dactylus with row of peg-like scales on outer margin; hollow accommodating ventrodistal spinose lobe of propodus, latter with several simple and dentate spines, plus dense cluster of ventrodistal slender finely serrate spines; carpus about half length of propodus; merus, ischium, basis, and coxa unarmed; flattened articulating plate at outer proximal part of coxa distally either with single spine and small papilla or (more often in Belize material), bispinose. First pleopods absent. Endopod of pleopod 2 with slender appendix interna bearing distal patch of short hooks; appendix masculina slightly shorter but broader than appendix interna, with 7 elongate simple distal setae. Outer uropodal ramus with row of 11 to 13 small spines along transverse articulation in distal quarter, strong articulating spine on outer margin at transverse articulation; outer surface with 2 strong rounded ridges, outer ridge bearing 4 spines; outer margin with 4 distal spines; inner uropodal ramus with 3 spines on outer (anterior) margin, single strong ridge

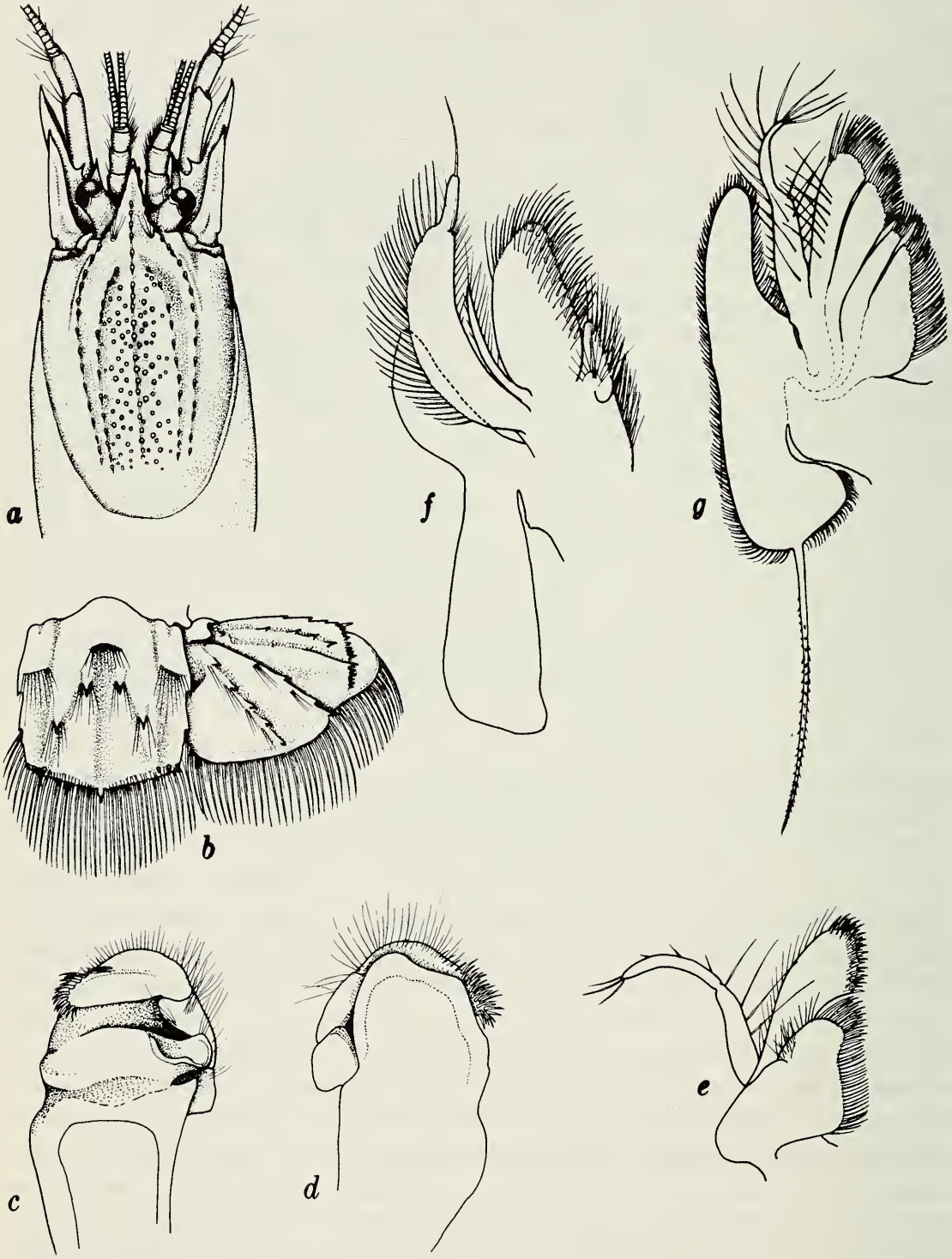

Fig. 2. *Axiopsis (A.) serratifrons*: **a,** Anterior carapace in dorsal view; **b,** Telson and right uropod; **c,** Mandible, inner view; **d,** Mandible, outer view; **e,** Maxilla 1; **f,** Maxilliped 1; **g,** Maxilla 2.

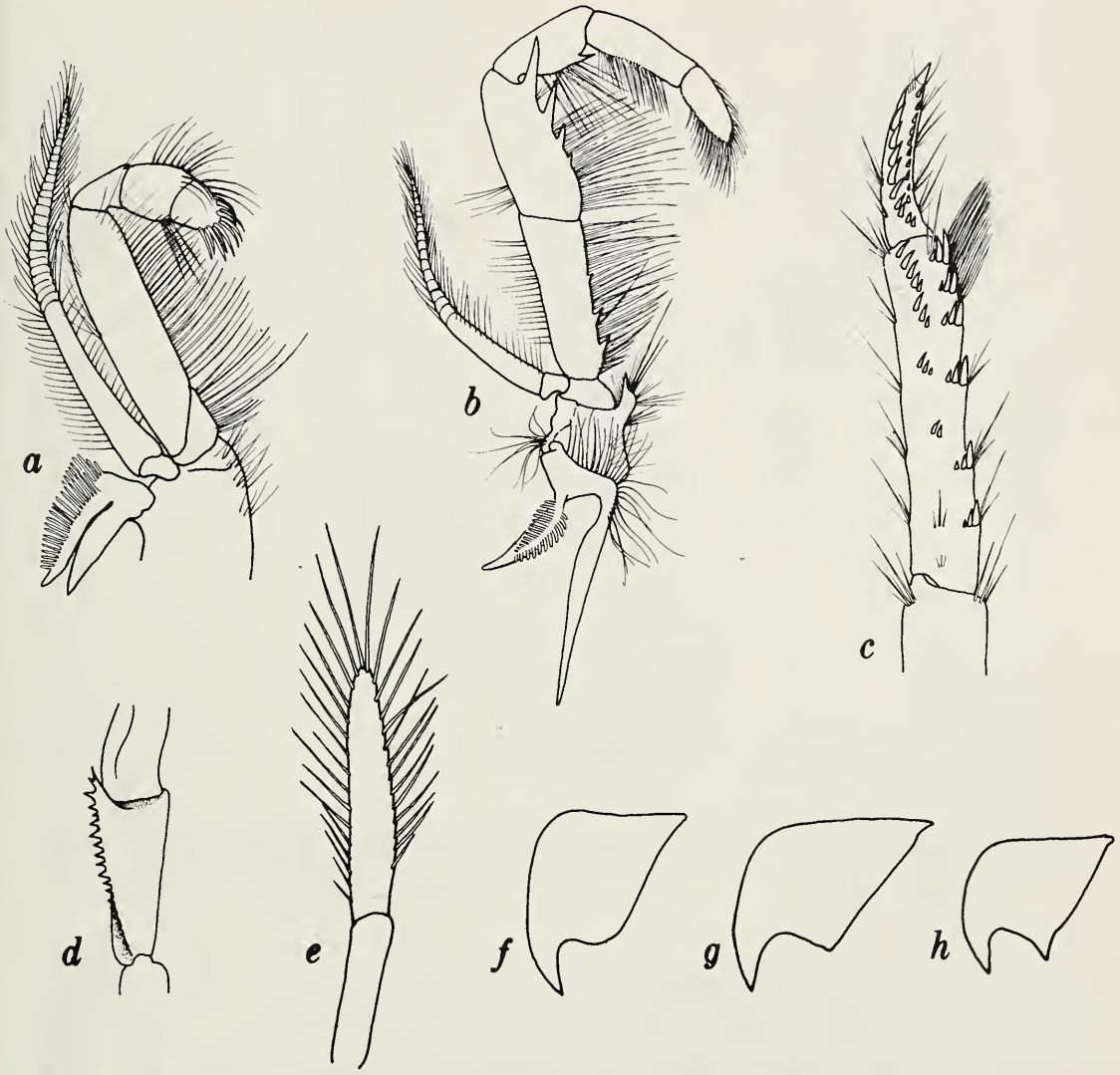

Fig. 3. **a,** *Axiopsis (A.) serratifrons*: Maxilliped 2; **b,** Maxilliped 3; **c,** Pereopod 4, dactylus and propodus; **d,** Maxilliped 3, inner view of ischium; **e,** Pleopod 1 ♀; **f,** Pereopod 5 coxal plate, Gilbert Island specimen; **g,** Pereopod 5 coxal plate, Bermuda specimen; **h,** Pereopod 5 coxal plate, Carrie Bow Cay specimen.

on outer surface bearing 5 spines. Telson with short median spine on distal margin; latter almost straight, with 3 small submarginal spines laterally; lateral margin with 2 strong spines; outer surface with 2 broadly rounded ridges each ending in strong spine on each half; distal margins of both uropodal rami and telson bearing dense plumose setae.

Female.—Essentially similar to male, first pereopods more robust. Pleopod 1 2-segmented, slender, distal segment bearing marginal plumose setae.

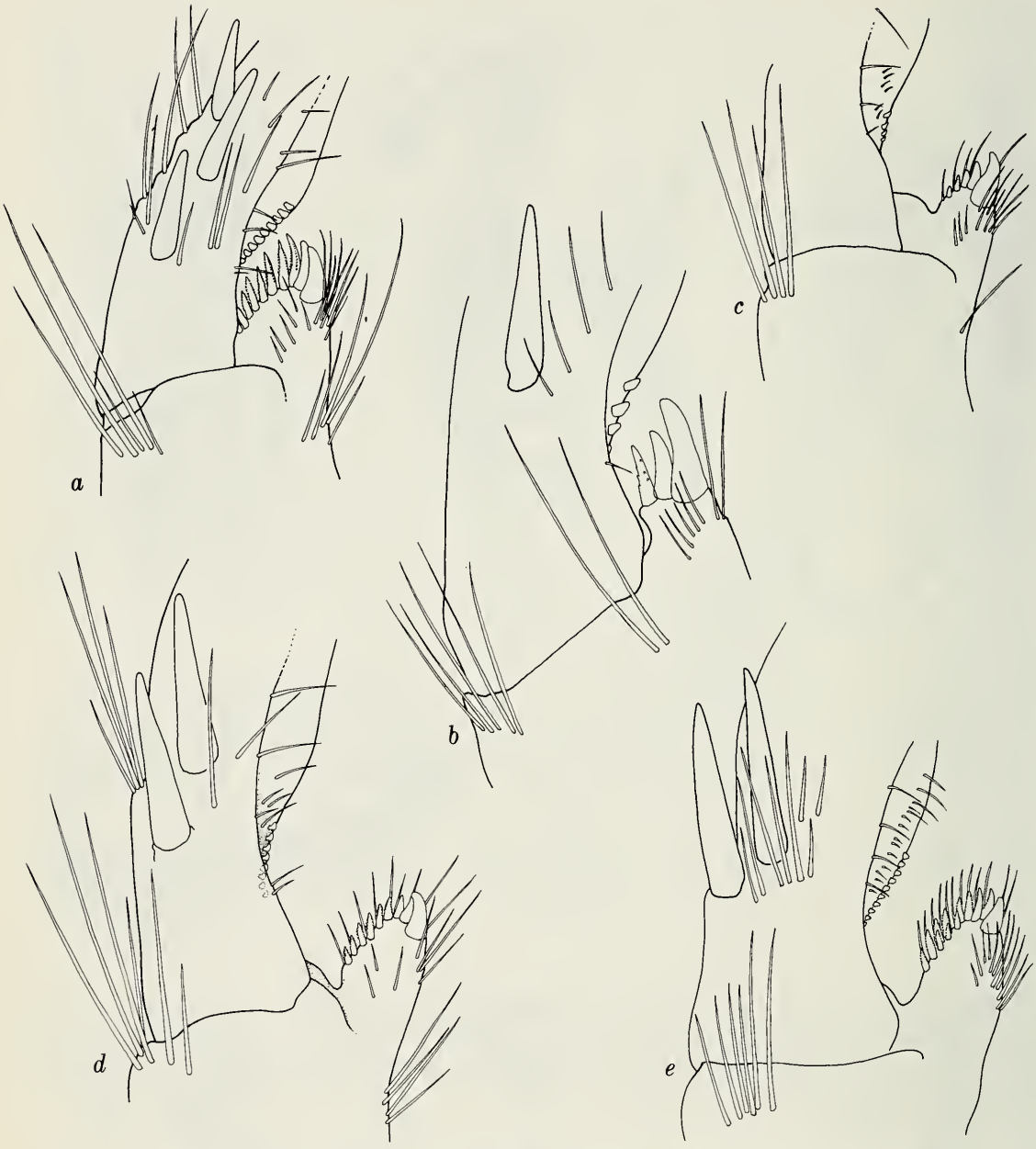

Fig. 4. *Axiopsis (A.) serratifrons*, grooming apparatus of pereopod 5: **a**, Gilbert Island; **b**, Zululand; **c**, Bermuda; **d**, Carrie Bow Cay; **e**, Florida.

Branchial formula.—

Maxilliped 2	epipodite + podobranch
Maxilliped 3	2 arthrobranchs, epipodite + podobranch
Pereopod 1	2 arthrobranchs, epipodite + podobranch
Pereopod 2	2 arthrobranchs, epipodite + podobranch
Pereopod 3	2 arthropods, epipodite + podobranch
Pereopod 4	2 arthrobranchs, epipodite

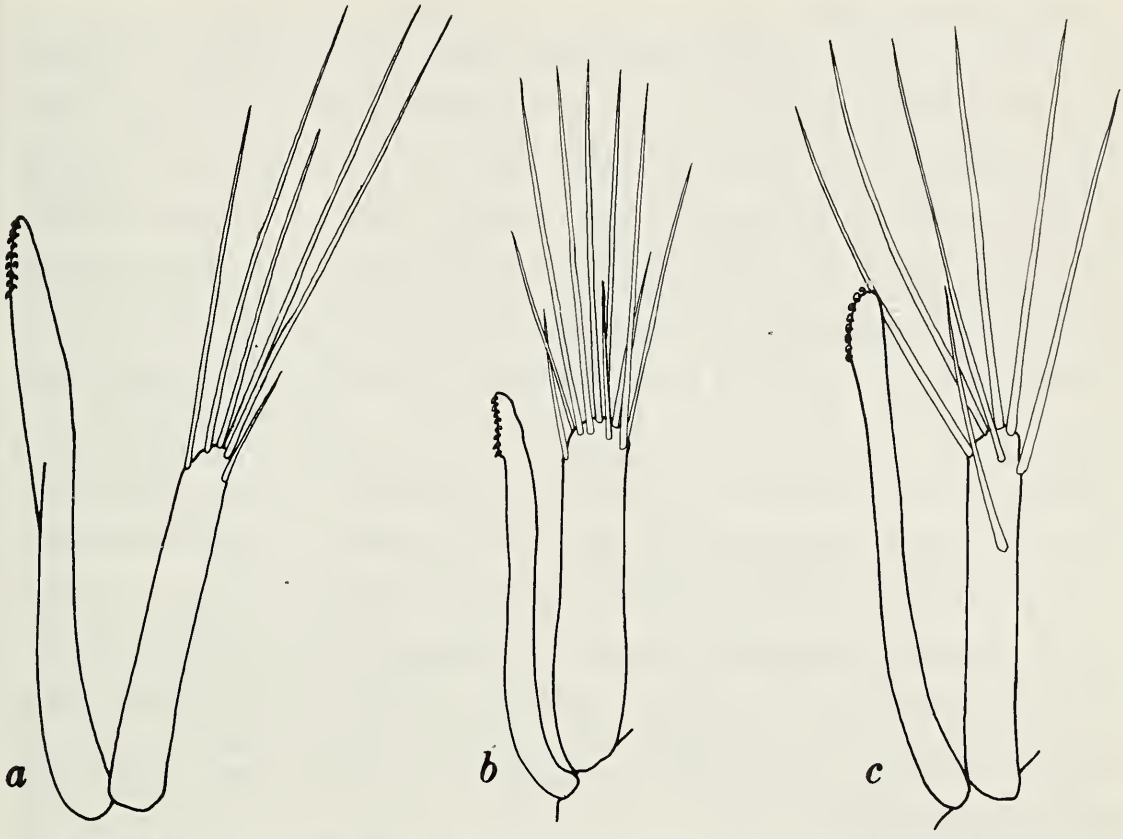

Fig. 5. *Axiopsis (A.) serratifrons,* appendix masculina and appendix interna: **a,** Bermuda; **b,** Gilbert Island; **c,** Carrie Bow Cay.

Color notes.—(Belize and Bermuda specimens.) Carapace, pleon, and appendages chestnut-brown to almost black in males (becoming purple-blue in alcohol), paler brown to olive green in females. Carapace with pale blotch on posterior branchiostegite and on anteroventral region of cervical groove. Pleura of pleonites 3 to 6 with pale anterior half; middorsal articulating areas of pleonites pale. Finger and thumb of both first chelae orange-brown, rest of cheliped dark.

Behavioral and biological notes.—The following observations were made at Carrie Bow Cay, Belize, where *A.* (*A.*) *serratifrons* was common in the back-reef area. The shrimps were confined to areas of coarse calcareous sands mixed with dead coral rubble and pieces of pavement rock, in water depths of 0.5–2.0 meters. An estimate of density was difficult, but one burrow per 5 m^2 would not be unreasonable.

The burrows were nearly always situated in shallow depressions, with two or three entrances visible between rubble pieces. The animals could sometimes be seen at the main entrance of the burrow, with the antennae exploring the surrounding area. Even with fish or conch bait, however, the animals could not be induced to leave the burrows.

During March 1980, a mature male and female were captured and placed in a narrow aquarium containing coarse sand and rubble, with circulating sea water. Burrow construction and feeding behavior were observed. When released onto the surface of the sand, rapid movements of the pleon produced a hollow which was soon enlarged by excavation. The first 2 pairs of pereopods plus the third maxillipeds, together with the elongate setae on their ventral margins, form an efficient basket capable of moving considerable quantities of sand, which were dumped beyond the margin of the excavation. Within 24 hours a branching burrow system had been excavated, with interlocking rubble pieces preventing sandfills. The rubble pieces were manipulated with the first pair of chelipeds, and when placed in position, rapidly vibrated as if to ensure or improve solidity. Construction and modification of the burrow continued throughout the 2 weeks of observations. During the day the shrimps never left the burrow, but at night roamed about the surface a little distance from the burrow entrance.

Food in the form of lumps of fish or conch would be dragged into the burrow, and held in place by the third maxillipeds while pieces were torn off by the mandibles. On several occasions, after feeding for a short while, the piece of food was crammed into a crevice and sand piled on top to cover it completely. This food item would be excavated later, more eaten from it, and reburied.

Ventilation of the burrow could sometimes be seen, with either the male or female sitting in the lowest part of the burrow, with the pleon fully extended and the pleopods beating rapidly.

Grooming was frequently performed, the entire body, especially the clumps of setae on the carapace, and the antennular and antennal flagella being combed by the grooming apparatus at the distal end of the fifth pereopods.

Distribution.—Pacific Ocean: Hawaii (type-locality); Palmyra Is.; Fanning Is.; Gilbert Is.; Bikini Atoll; Samoa; Palau Is.; Noordwachter Is. (Java Sea); Ambon Is., Obi Is., Damar Is., Lucipara Is., Kur Is., Roti Is. (Indonesia). Indian Ocean: Maldive Is.; Chagos Archipelago; Obock (French Somaliland), Red Sea; Zululand (South Africa). Atlantic Ocean: Belize; Florida; Bermuda.

Material examined.—Onotoa, Gilbert Islands, from tidepool; 2 Aug. 1951; det. L. B. Holthuis ovig. ♀, USNM 95559, CL 12.1 mm, TL 29.2 mm; ♀, USNM 95561, CL 14.3 mm, TL 33.2 mm; ♂, USNM 95561, CL 15.0 mm, TL 35.0 mm. Narnu Is., Bikini Atoll, back reef in lagoon, 3 Apr. 1946; det. L. B. Holthuis. ♂, USNM 95560, CL 11.1 mm, TL 27.6 mm. Sodwana Bay, Zululand, South Africa, offshore reef, 50 ft, 24–28 July 1976; ♀, South African Museum, CL 8.8 mm, TL 22.5 mm; 2 juv., South African Museum, CL 6.9 mm, 5.5 mm, TL 17.4 mm, 13.4 mm. Carrie Bow Cay, Belize, back reef coral rubble and coarse sand, 1–2 m, Mar. 1980; ovig.

♀, USNM 18905, CL 23.0 mm, TL 59.0 mm; ♀, USNM 18905, CL 17.8 mm (damaged); 4 ♂, USNM 18905, CL 19.5 mm, 19.0 mm, 15.6 mm, 11.8 mm, TL 50.5 mm (damaged), 39.1 mm, 29.3 mm. Carrie Bow Cay, Belize, coral patches, 1 m, 16 May 1977; 2 juv., USNM 18908, CL 6.0 mm, 5.3 mm, TL 14.0 mm, 12.3 mm. Carrie Bow Cay, Belize, 14 May 1977; juv., USNM 18907, CL 4.2 mm, TL 10.2 mm. Pigeon Key, Monroe County, Florida, under dead coral slab, 2 m, 29 May 1970; ♂, USNM 18903, CL 23.0 mm, TL 62.0 mm. Pigeon Key, Monroe County, Florida, under dead coral, 1.5–2 m, 20 Nov. 1969; ♂, USNM 18904, CL 22.4 mm, TL 58.0 mm. North Rocks, Bermuda, 10 m, 7 Oct. 1976; ♂, juv., CL 15.3 mm, 5.0 mm, TL 40.0 mm, 12.9 mm.

Discussion.—The presence of a transverse suture on the outer uropodal ramus, the rounded posterodorsal carapace, the rostrum continuous with the gastric region, elongate antennal spines, and pigmented eyes, place the present species in *Axiopsis* (*Axiopsis*), using de Man's key (1925:1). This definition may be expanded to include a triangular rostrum with dentate margins, unequal first chelipeds with fingers shorter than palm, telson with spinose dorsal keels, pleopod 1 absent in male, and pleopod 2 with rod-shaped appendix interna and appendix masculina. The present species agrees with all these features, and falls into that group of species having five spinose carinae in the gastric region of the carapace. de Man's key to the species of *Axiopsis* leads to *A. serratifrons* (A. Milne Edwards), a species which possesses numerous spines or tubercles between the median and submedian carinae. Although widely distributed throughout the Indo-Pacific, this species has not previously been recorded from the Atlantic.

That *A. serratifrons* from the Indo-Pacific is a variable species, was noted by de Man (1925) when he drew *A. affinis* and *A. spinipes* into the same species. (Borradaile 1903, designated the former as the type-species of the genus.) This variation, also seen in the Atlantic specimens, is to some degree a function of age, the larger and smaller first chelae being more noticeably different in older and fully mature specimens. Variation is also seen in several other morphological features, in addition to the chelipeds. These are summarized in Table 1.

The coxal plate of pereopod 5 varies from having the anterodistal corner rounded, through rectangular, to a spinose condition. In the Belize sample of 6 specimens, this plate is either bispinose or rectangular/spinose, with no apparent correlation with age.

The ventrodistal grooming lobe of the propodus of pereopod 5 is armed with a varying number of dentate and smooth spines, which also vary in relative lengths.

The ratio of length of appendix masculina to appendix interna ranges from 0.6 to 0.9, but may be a function of maturity. The appendix masculina bears a varying number of elongate terminal setae (6–10).

Table 1.—Comparison of material of *A. serratifrons* from 5 localities.

	Belize	Bermuda	Florida	Gilbert Is., Bikini At.	Zululand
Carapace carinae spination					
1 (left)	19–22	20	20–21	18–22	17–19
2	12–14	13	13–14	12–14	10–11
3 (median)	20–24	23	23	14–22	15–17
4	12–14	13	13	12–15	10–12
5 (right)	20–24	20	19–21	17–21	17–19
Marginal spine on pleura	1, 3–6	1, 3–6	1, 3–6	1, 3–6	1, 3–6
Pereopod 1					
Larger chela, length/width	2.1 1.8 1.6	1.6	1.9	1.7 1.6 1.5	1.9
Smaller chela, length/width	2.2 2.5 2.1	2.1	2.7	2.1 1.9	2.3
Pereopod 5, coxal plate	Rectangular to bispinose	Rectangular	Rectangular	Rounded	Rectangular
Pereopod 5, grooming lobe of propodus, spination	9	5	12	10	3
Appendix masculina/appendix interna	0.7	0.6	0.7	0.9	♀
Appendix masculina setation	7 terminal	6 terminal	9 terminal	10 terminal	♀

The palm length/width ratio of the first chelae varies considerably, with the smaller chela being consistently more slender.

Variation in the degree of pitting of the carapace and rugosity of the chelae can also be seen, but is difficult to describe other than in relative terms.

From Table 1 it is difficult to justify splitting the present material either into species or subspecies. The Atlantic population perhaps represents an incursion from the Pacific which took place at a time when the Isthmus of Panama was submerged. A record of the species from the eastern Pacific would strengthen this surmise.

The species recorded by Sakai (1970) as *Axiopsis* (*Axiopsis*) sp. aff. *serratifrons* from Tsushima Is., Japan, is almost certainly not this species, as both the acute anterior margin of the carapace, and the more spinose merus and ischium of maxilliped 3 (as figured by Sakai) differ markedly from Milne Edwards' species.

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